

Synchrotron Measurements of Jupiter's Inner Radiation Belts

M. J. Klein (1), S. J. Bolton (1), S. Gulkis (1), M. A. Janssen(1) S. M. Levin (1) and R. Thorne (2)

(1) Jet Propulsion Laboratory, California Institute of Technology, (2) Dept. of Atmospheric Sciences, UCLA

Jupiter's radio emission above 100 MHz (300 cm wavelength) comprises thermal emission from the atmosphere and non-thermal synchrotron emission generated by relativistic electrons trapped in Jupiter's radiation belts. Because the theory of synchrotron emission is well developed, observations of the synchrotron component of Jupiter's radio emission provide useful information for improving our knowledge of the inner radiation belts within a few Jovian radii. Key components of the observations include ground-based measurements of the synchrotron emission spectrum, the spatial distribution and polarization of the synchrotron radio emission, and detailed studies of the time history of all of these parameters. Temporal variations are observed over a range of time-scales from the well-understood 10-hour rotation period to the unexplained intensity variations that occur over weeks, months and years.

In this paper we discuss recent observations on the study of synchrotron radio emission from Jupiter's inner radiation belts ($R < 4 R_J$). We review results of the unique opportunity to measure accurately the Jovian synchrotron radiation at a wavelength of 2.2 cm from the Cassini spacecraft as it flew past Jupiter in January 2001. The experiment successfully produced 20 maps covering two complete rotations of Jupiter in both horizontal and vertical linear polarization. Synchrotron emission was clearly detected distinct from the thermal emission as evidenced by its polarization and spatial distribution. These maps provide unique information on the highest energy electrons in Jupiter's magnetosphere. The Cassini flyby was supplemented with ground-based observations at several other wavelengths using the Very Large Array and NASA's Deep Space Network (DSN). Results from these observations will also be discussed.

The goal of the synchrotron emission studies is to understand the source of the electrons by incorporating into a model details on the spatial, energy and pitch angle distribution of the radiating electrons and to learn how and why these distributions vary with time. Recent measurements that show variations of the intensity and spatial features of the synchrotron emission will be discussed and compared with our model predictions.

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